The Met Office GloSea5 System

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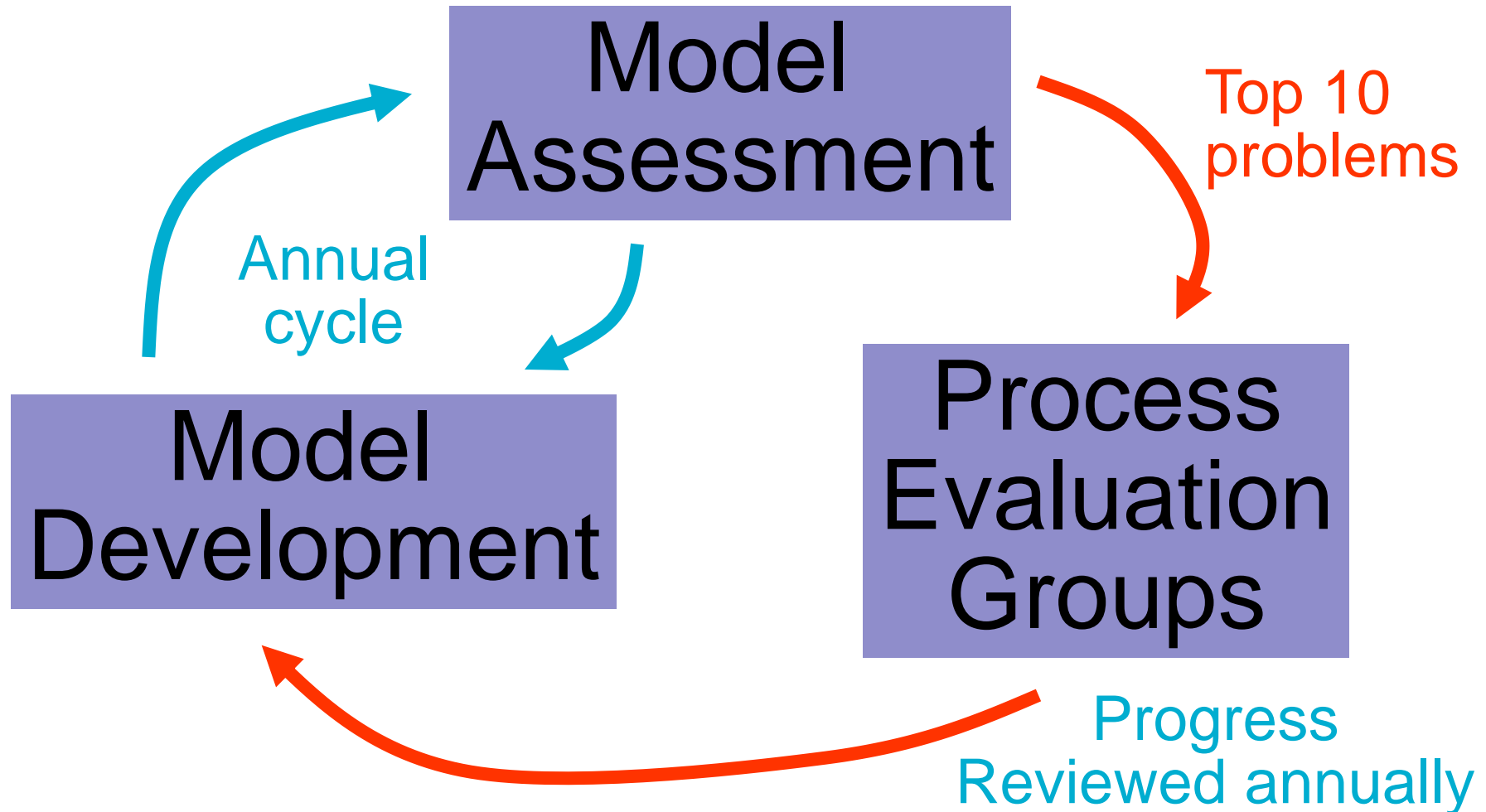
NMME subseasonal forecast system exploratory workshop, March 2015

Global Seasonal Forecast System version 5 (GloSea5)

- ensemble prediction system

- the source for Met Office monthly and seasonal forecasts

- uses a coupled model (atmosphere—land-surface—ocean—sea-ice)

- regular updates

- linked to model development cycle (~ yearly)

- hindcasts computed in near-real time

Met Office model development process

Model Assessment

Process Evaluation Groups

Model Development

Top 10 problems

Annual cycle

Progress Reviewed annually

GloSea5 operational system

Model version: **HadGEM3 GC2.0 (UM / NEMO / CICE / OASIS)**

Resolution: **N216L85 O0.25L75** (mid-lat: ~60 km atm.)

Forecast length: **7 months (seasonal),**
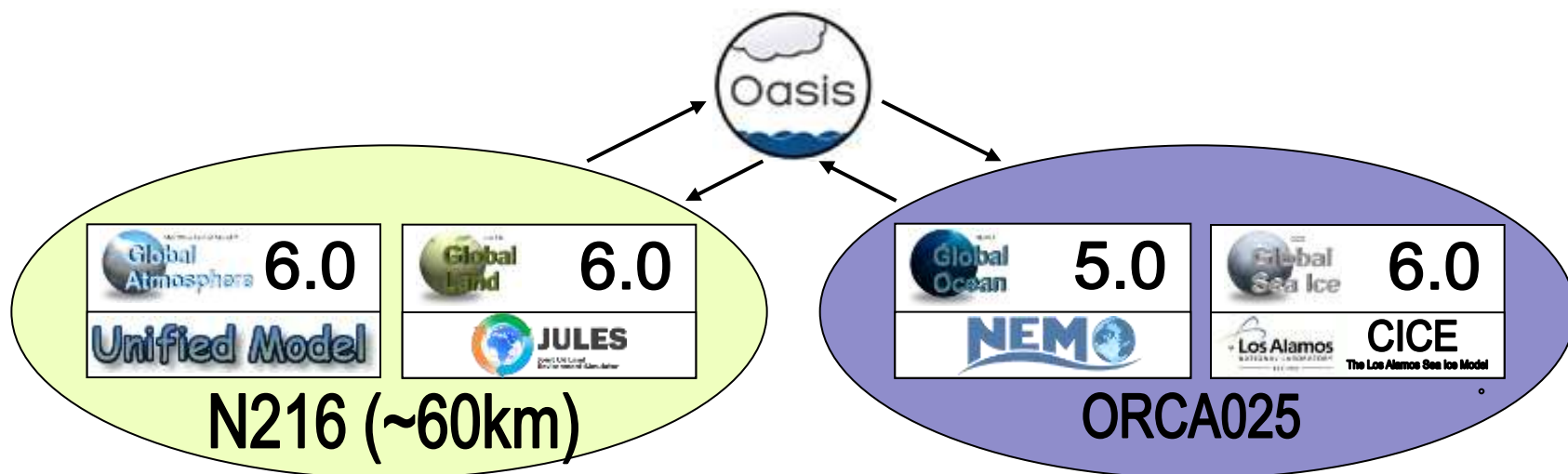
2 months (sub-seasonal)

Hindcast period: **1996-2009 (14 years)**

Model uncertainties represented by stochastic physics

Initial conditions uncertainties represented by a lagged ensemble

GC2.0

Global Coupled modelling configuration

N216 (~60km)

ORCA025

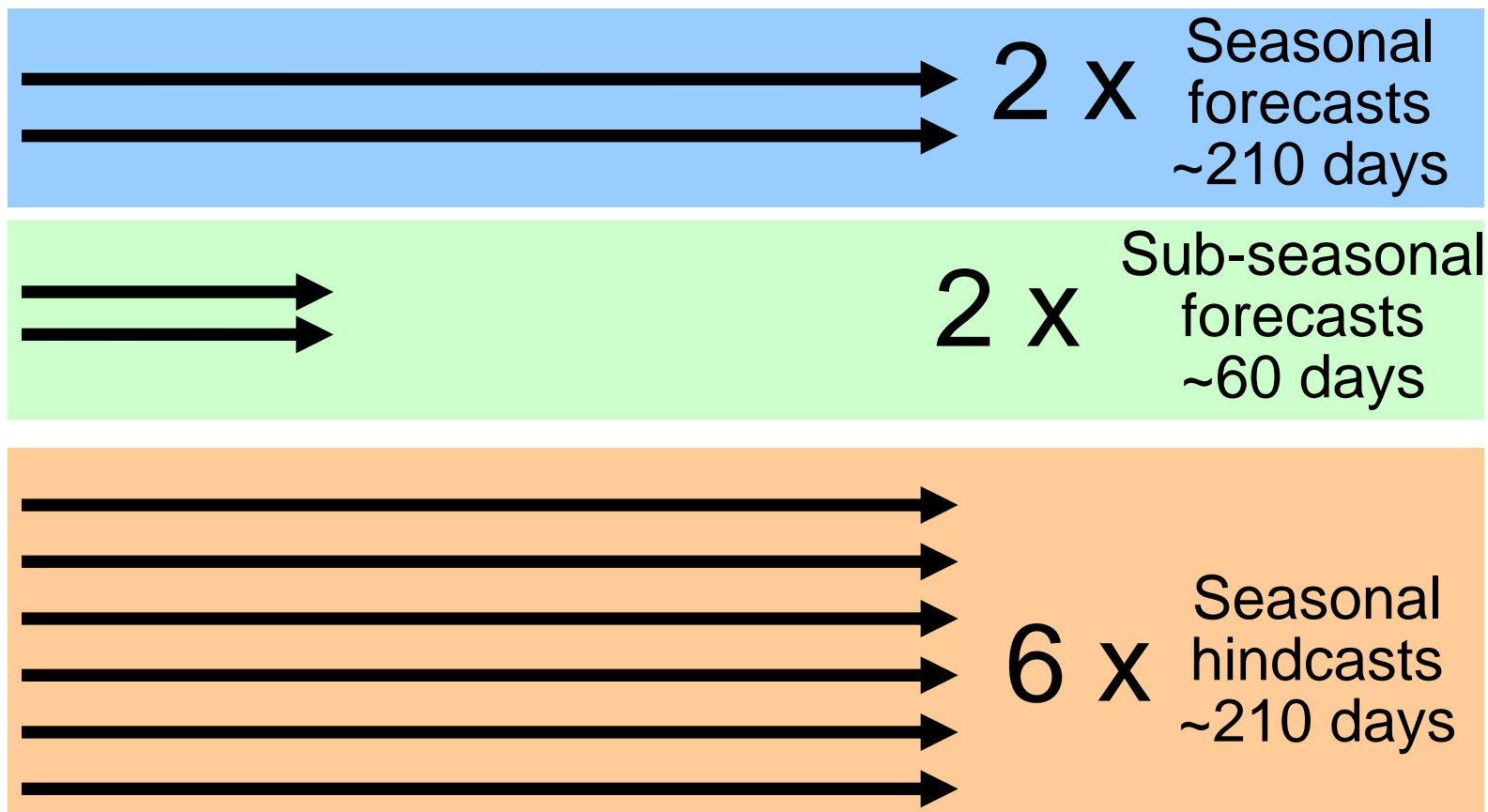# Initialisation of the system

Forecast (initialised daily):

- Atmosphere & land surf *: Met Office NWP analysis (4d-Var)

- Ocean & sea-ice: NEMOVAR (3d-Var joint system for ocean, med-range, monthly and seasonal)
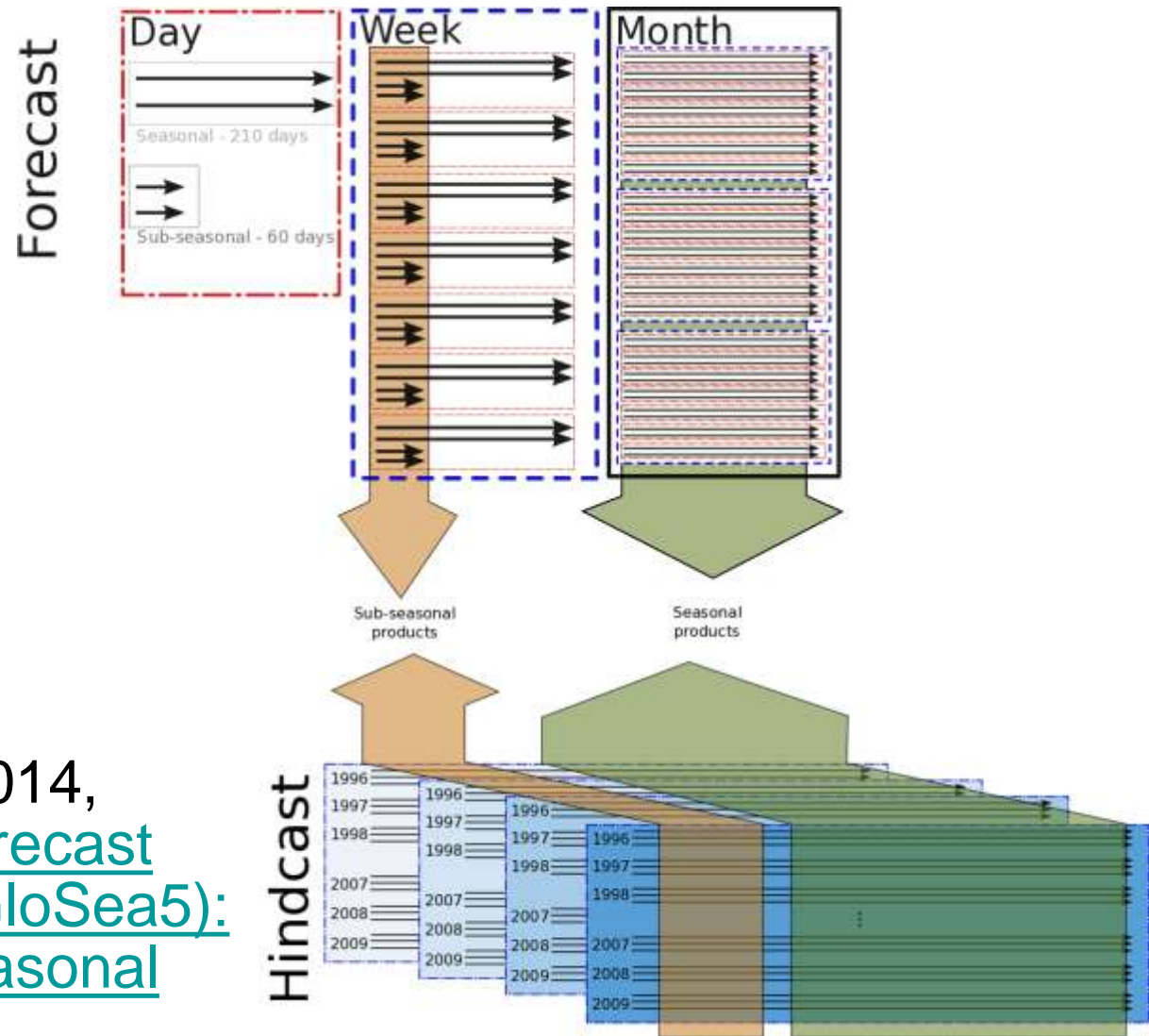
14-year hindcast (1996-2009):

- Atmosphere & land surf *: ERA-interim

- Ocean & sea-ice: NEMOVAR

- Fixed start dates of 1st, 9th, 17th, 25th of each month

- 3 members per start date

* Soil moisture set to climatological average

A day in the life of GloSea5

2 x Seasonal forecasts ~210 days

2 x Sub-seasonal forecasts ~60 days

6 x Seasonal hindcasts ~210 days

A month in the life ….

MacLachlan et al, 2014, Global Seasonal Forecast System version 5 (GloSea5): a high resolution seasonal forecast system

Examples of products (for internal use)
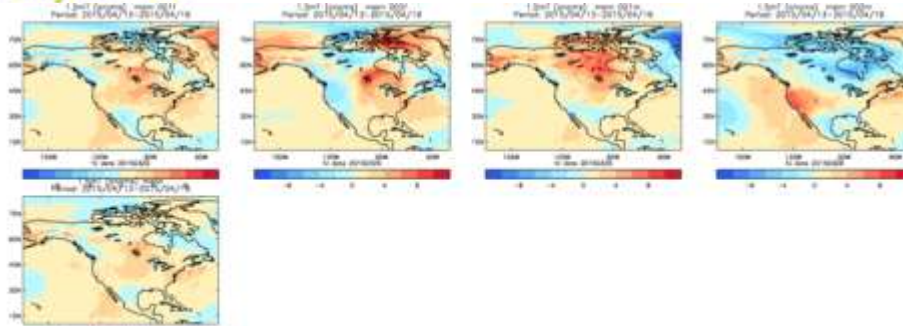
Forecast maps

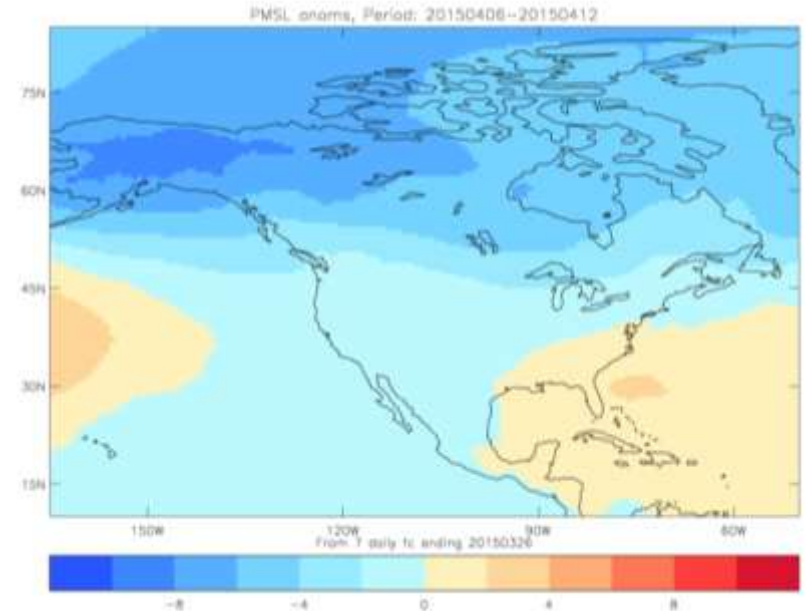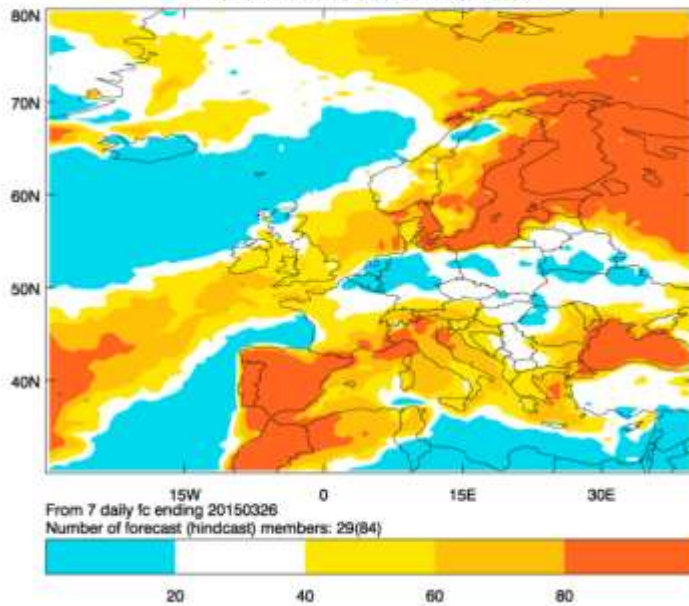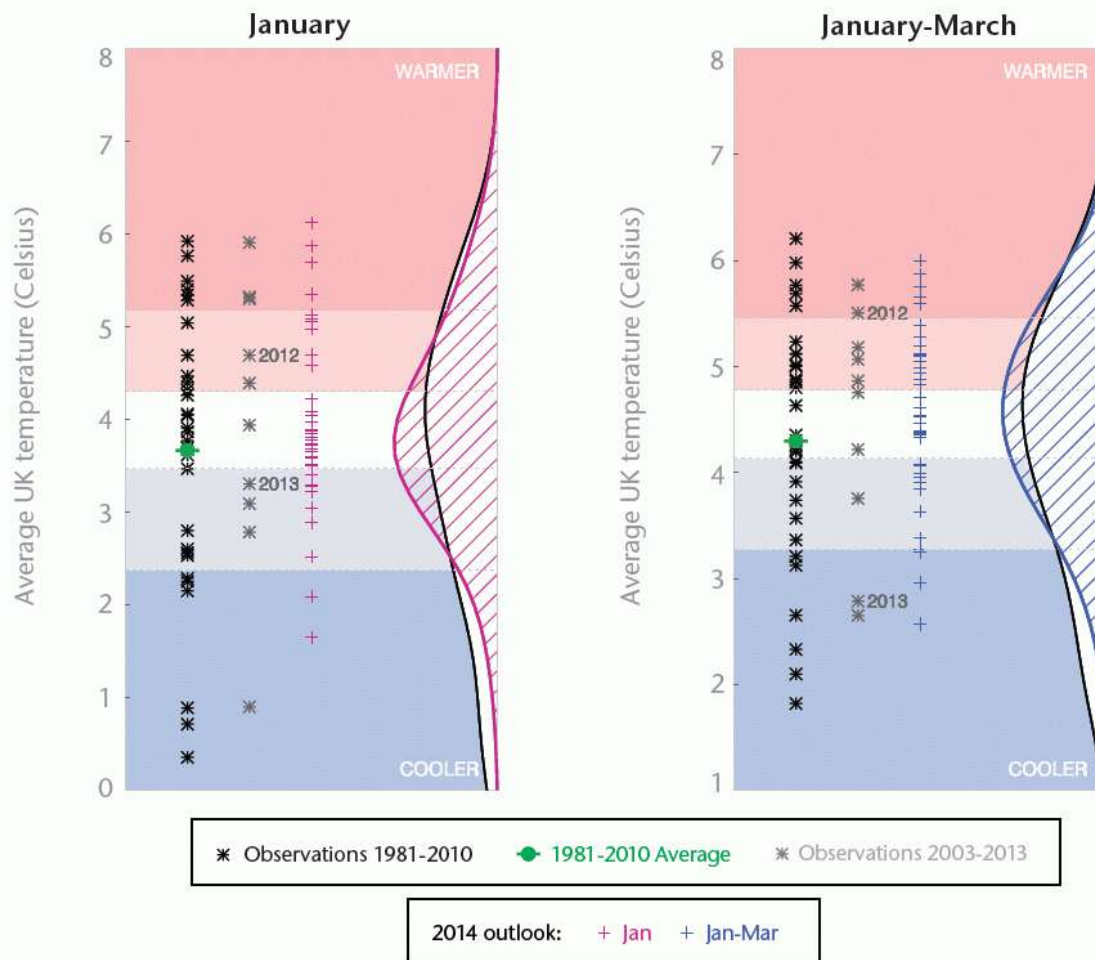# Timeseries (plume diagrams)
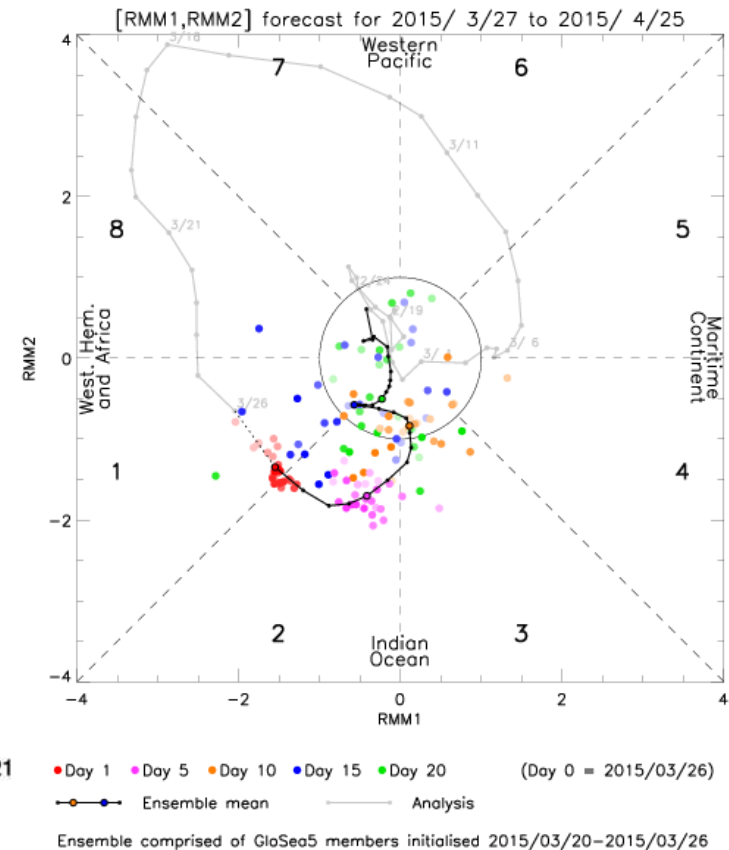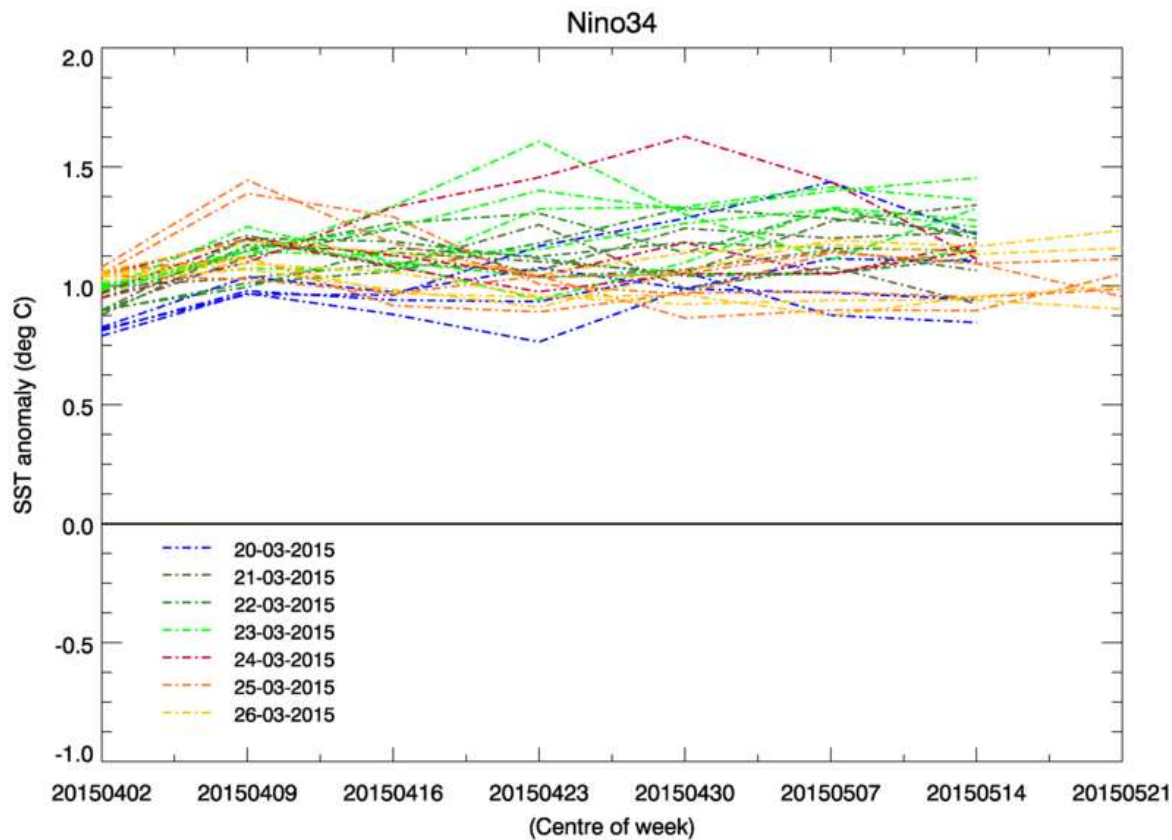
1- and 3-month outlook for the UK

1-month and 3-month UK outlook for temperature in the context of observed climatology

http://www.metoffice.gov.uk/publicsector/contingency-planners
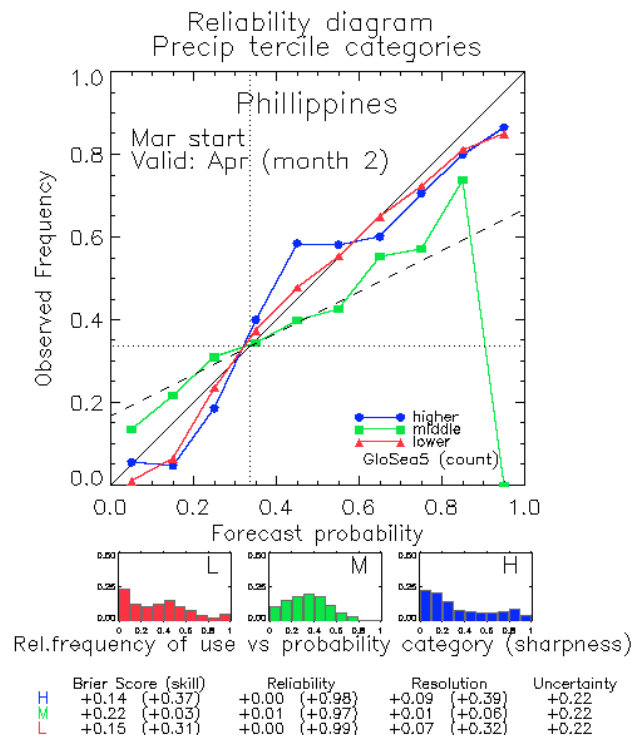
Skill of forecasting system

How to assess the model and the system with a small hindcast sample?

- average skill estimated on the hindcasts

- case studies

- process-based assessment (from free-model runs, idealised model experiments and initialised hindcasts) - focus on processes related to sources of predictability
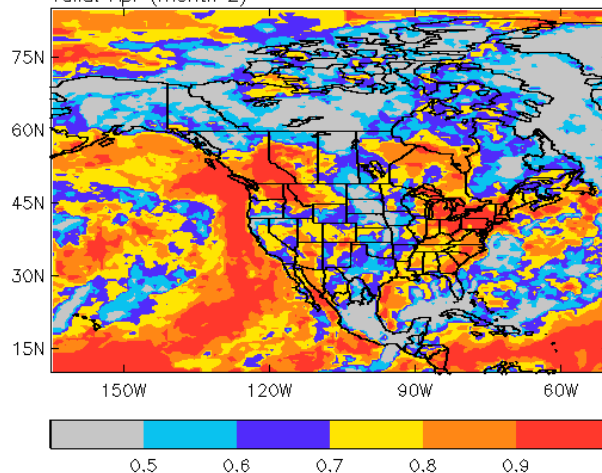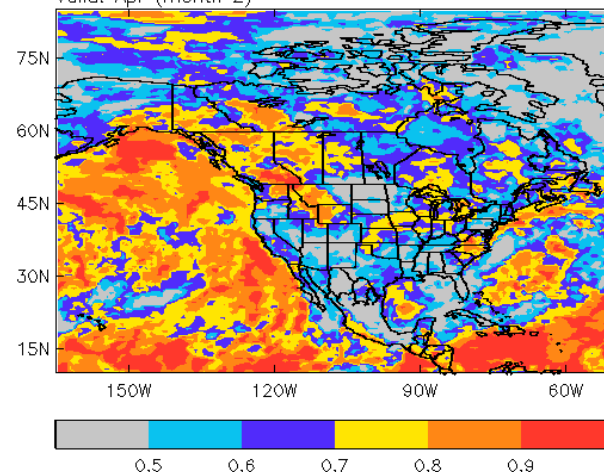
Some skill scores
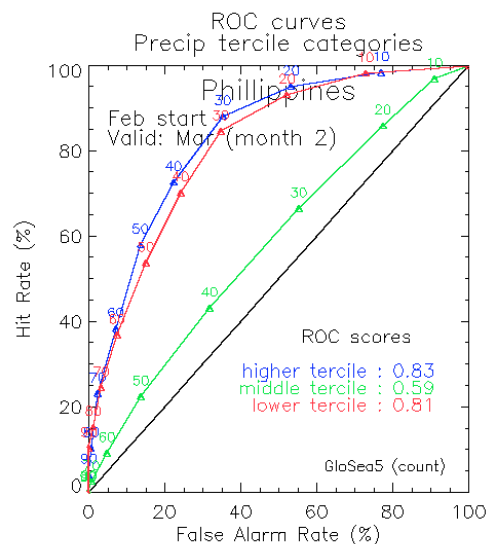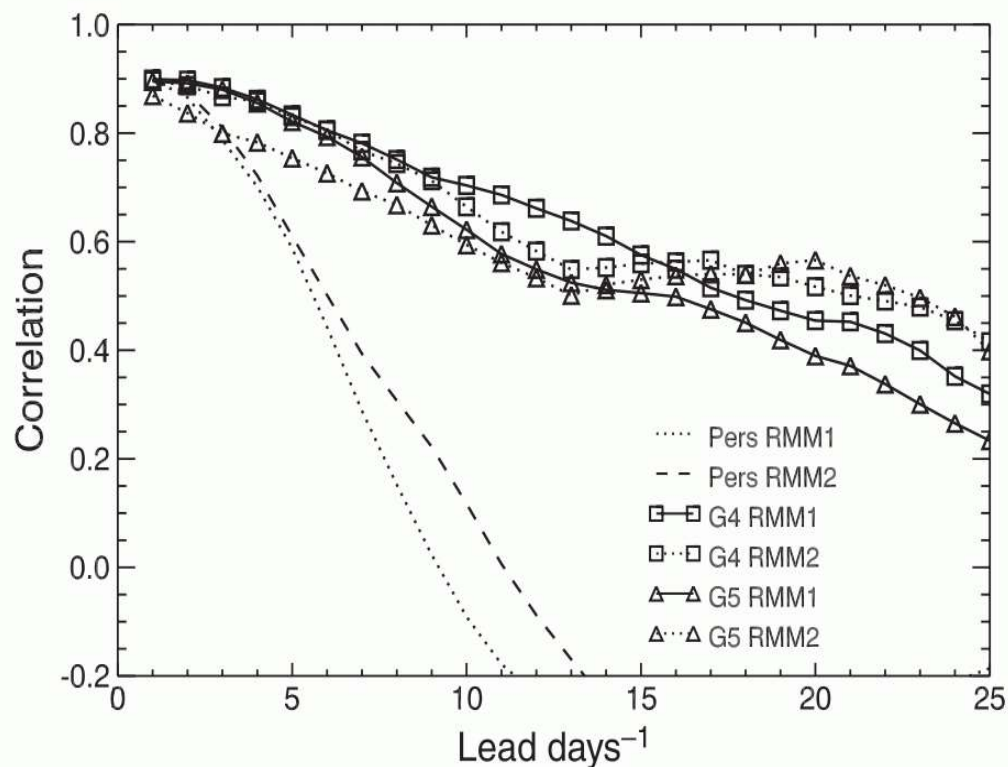

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Some skill scores
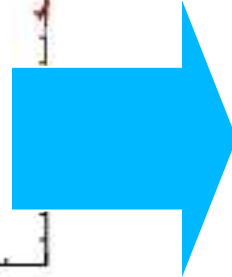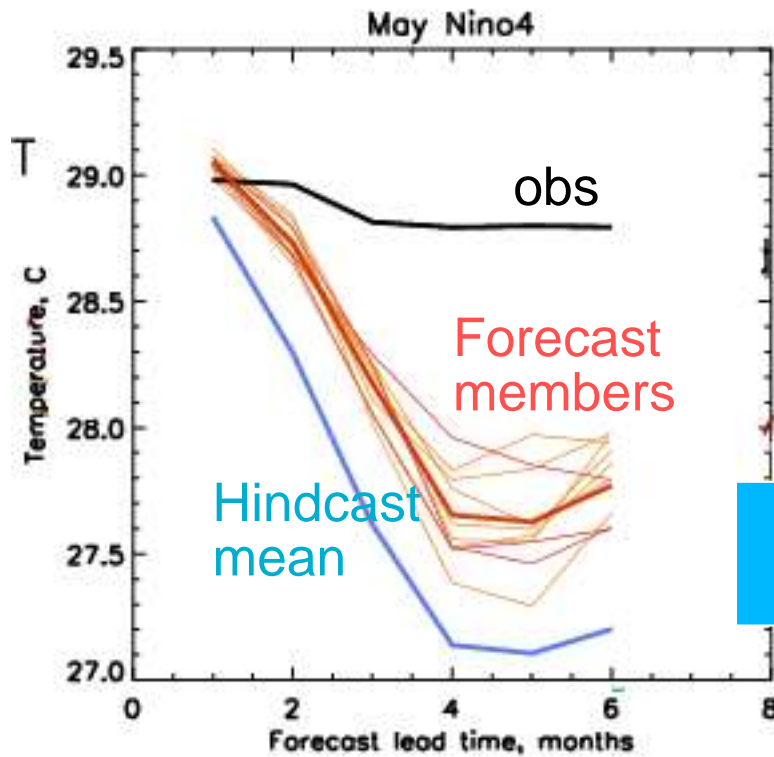# Madden–Julian Oscillation, MJO

GloSea5 shows skill out to 15 – 20 days.

This suggests potential for sub-seasonal timescale prediction.

However, uninitialised model runs do not represent the MJO well; need to understand why.

Model bias

Bias-corrected forecast
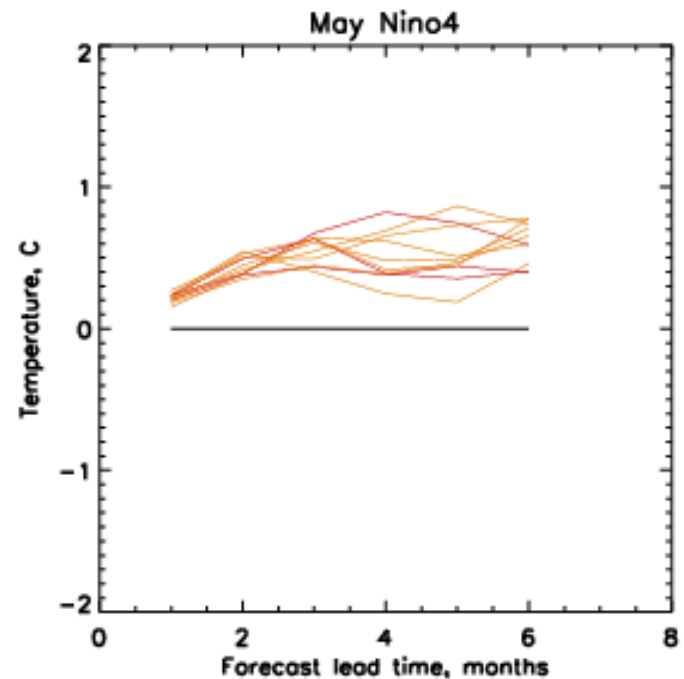
At long range, predict anomalies

Model bias

China (90°-120°E, 30°-45°N) 1.5m Temperature 1996-2009 for ERA-Interim (black) and Glosea4 hindcasts (colour)

Anomaly: Hindcast minus ERA-I

Biases are lead time dependent; can be large.

Processing for bias correction is not trivial.

Use these estimates to identify model inadequacies.

Soil moisture initialisation
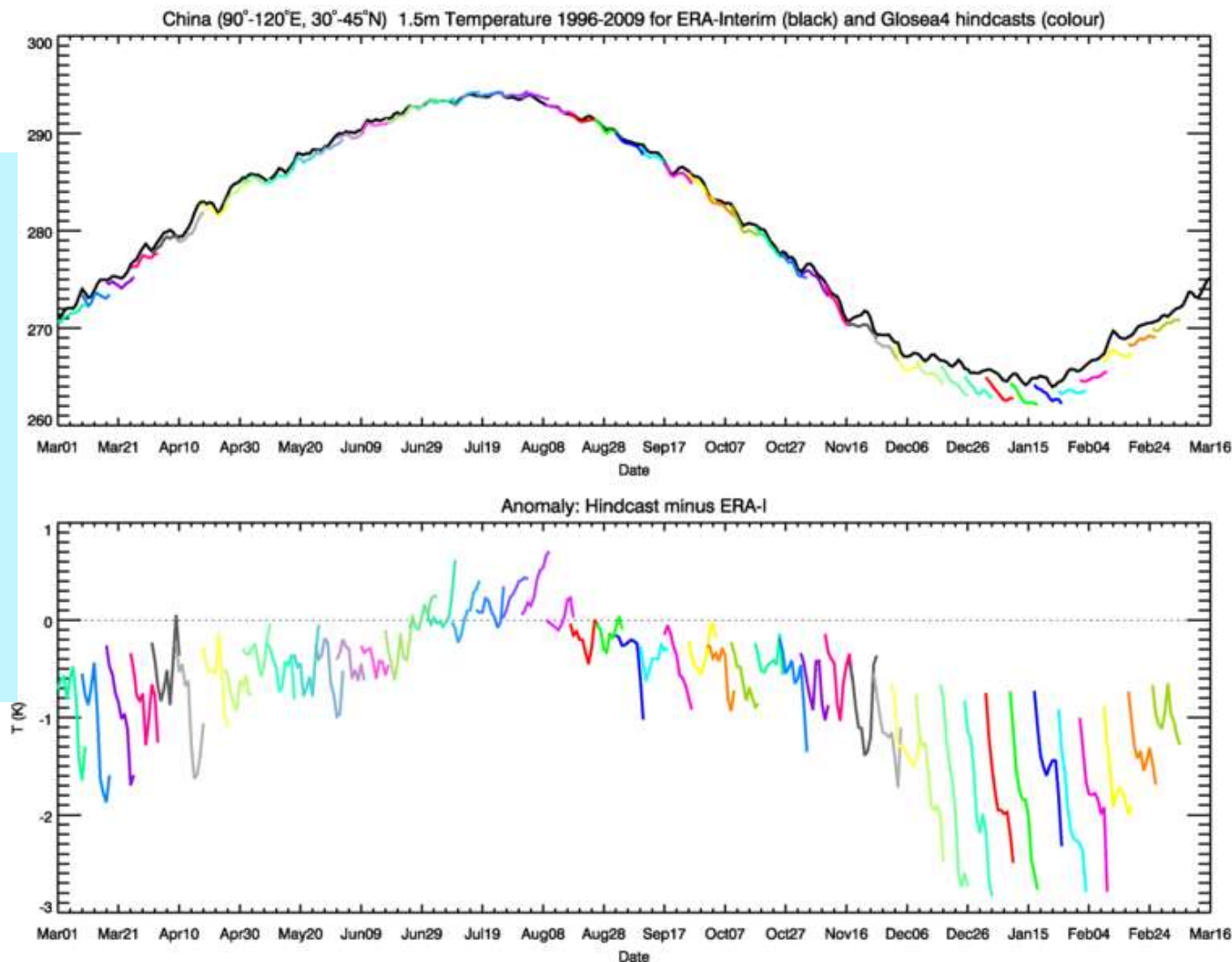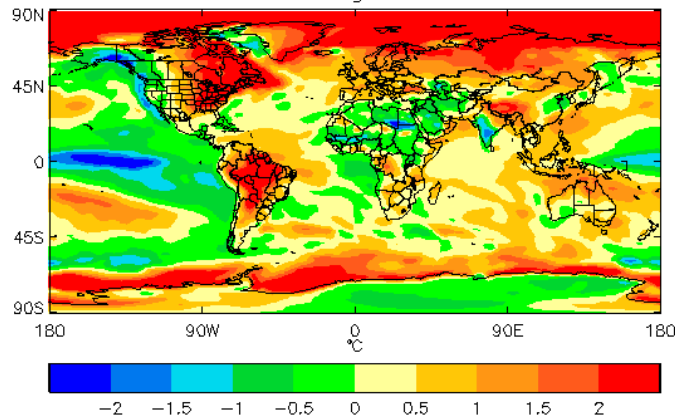

Ensemble mean anomaly : 2m temperature : Sep/Oct/Nov
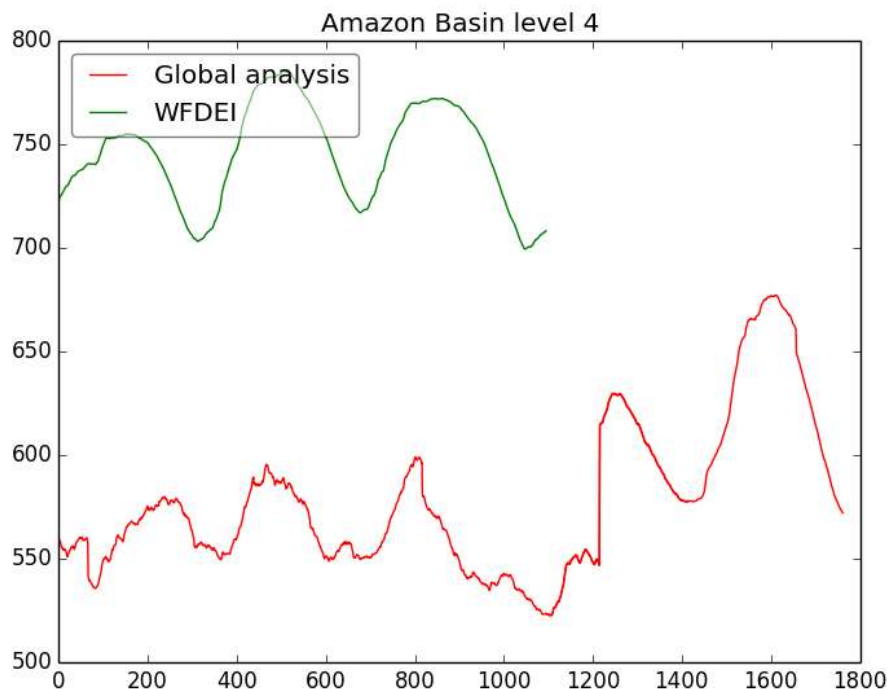Issued August 2010

Ensemble mean anomaly : 2m temperature : Sep/Oct/Nov
Issued August 2011
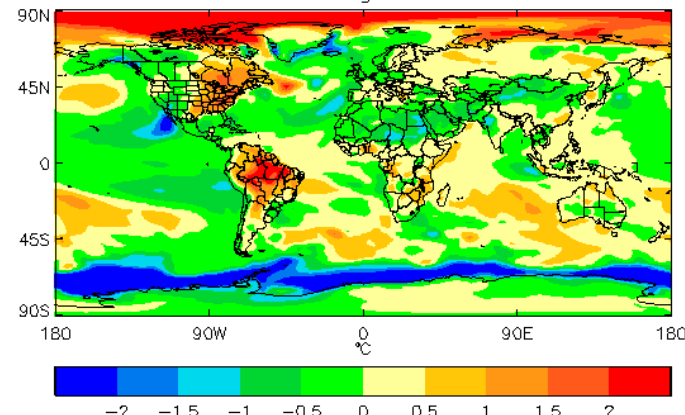
Very large discrepancy between analysis for hindcast (green) and forecast (red).

So far no way of reconciling the differences, so initialisation is switched off.

Potentially missing out on important source of predictability.

Amazon Basin level 4

- Global analysis
- WFDEI

What next?

- further model development, and related updates to operational system; focus on tropical convection
- higher horizontal resolution (N512, in approx 2 years)
- 'international' forecasting system: GloSea5 at KMA
  - larger forecast ensemble
  - larger hindcast sample
- products:
  - tropical storm activity (subseasonal): numbers, ACE, tracks
  - improved bias correction
  - improved interface for forecasters

- no immediate plans for subseasonal-specific hindcast

Computer resource

- 34,560 cpu hours per day

- 4% of Met Office HPC

- 12.6 million cpu hours per year

- 304 GB per day

- 108 TB per year

- 1800 days simulated per day

Questions?

Monthly to Decadal Variability and Prediction – the team:

Adam Scaife, Craig MacLachlan, Drew Peterson, Nicola Martin, Doug Smith, Jo Camp, Rosie Eade, Richard Graham, Michael Vellinga, Jeff Knight, David Fereday, Leon Hermanson, Nick Dunstone, Sarah Ineson, Andrew Colman,   and more